

CLAIMS

1. A method of manufacturing a silicon single crystal by Czochralski method without performing Dash Necking method, comprising the steps of:

providing a seed crystal having a tip end with a sharp-pointed shape or a truncation thereof in which an angle of the tip end is 28° or less;

keeping the tip end of the seed crystal at just above a silicon melt to heat it before bringing the tip end of the seed crystal into contact with the silicon melt;

subsequently, bringing the tip end of the seed crystal into contact with the silicon melt and immersing the seed crystal into the silicon melt to a desired diameter; and then

shifting to pull the single crystal,

wherein a temperature variation at a surface of the silicon melt is kept at $\pm 5^{\circ}\text{C}$ or less at least for a period from a point of bringing the tip end of the seed crystal into contact with the silicon melt to a point of shifting to pull the single crystal.

2. The method of manufacturing a silicon single crystal according to claim 1, wherein the seed crystal is brought into contact with the silicon

melt and immersed therein with setting a temperature of the silicon melt when bringing the tip end of the seed crystal into contact with the silicon melt to 10 - 20 °C higher than a temperature appropriate for bringing the seed crystal into contact with the silicon melt in a method of manufacturing a silicon single crystal using Dash Necking method, and the single crystal is pulled with setting a pulling rate to 0.5 mm/min or less at least when forming a decreasing diameter portion for a period from a point immediately after stopping lowering of the seed crystal and shifting to pulling to a point of starting enlargement of a diameter of the crystal formed below the seed crystal.

3. The method of manufacturing a silicon single crystal according to claim 2, wherein the single crystal is pulled while a horizontal magnetic field with a magnetic field intensity of 1000 G or more at a center thereof is applied to the silicon melt at least for a period from a point of bringing the tip end of the seed crystal into contact with the silicon melt to a point of completing formation of a decreasing diameter portion formed below the seed crystal and starting enlargement of the diameter of the crystal.

4. The method of manufacturing a silicon single crystal according to any one of claims 1-3, wherein a silicon single crystal having a crystal orientation of $\langle 110 \rangle$ is pulled by using a seed crystal having a crystal orientation of $\langle 110 \rangle$.

5. A silicon single crystal grown by Czochralski method, which has a crystal orientation of $\langle 110 \rangle$, and a constant diameter portion with a diameter of 200 mm or more.

6. The silicon single crystal according to claim 5, wherein total weight of the single crystal pulled from the silicon melt is 100 kg or more.

7. A silicon wafer, wherein a main diameter of the wafer is 200 mm or more, and a plane orientation of a main surface of the wafer is (110).